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ABSTRACT

This autoinstructional lesson deals with the study of molecular biology. It is suggested as relevant to high school biology courses. No prerequisites are suggested. Two behavioral objectives are given leading to the learning of nucleotide bases, their parts, and the ways they pair as they do. The time suggested for this learning activity is about 12 minutes. Equipment necessary is listed. A work sheet to facilitate student evaluation accompanies the script. (EB)

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# DNA STRUCTURE

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TEACHER'S GUIDE

| | |
|---|---|
| PACKET NUMBER | 575.1<br>H |
| SUBJECT | Molecular Biology |
| TITLE | DNA Structure |
| LEVEL | High School |
| PREREQUISITES | None |
| BEHAVIORAL OBJECTIVES | 1. To be able to draw the DNA ladder labeling the following parts - phosphoric acid, deoxyribose sugar, adenine, thymine, quanine, cytosine.<br><br>2. To be able to list the pairs formed by the nucleotide bases and to cite a reason why they pair as they do. |
| EQUIPMENT | Envelope A with DNA strip<br>2 slides<br>Slide projector<br>Cassette tape<br>Tape recorder<br>Work sheet |
| TIME | 12 minutes |
| SAMPLE EVALUATION | Work sheet |
| SPACE REQUIRED | Carrel |

SCRIPT

MOLECULAR BIOLOGY
DNA STRUCTURE

We have mentioned DNA on several occasions, but what is it that is so important about this molecule? Since Watson and Crick first described its makeup in 1953, the study of biology has taken on a new light. You may have heard DNA called the key to life. It is the key because it is in charge of all the processes that go in a living cell. If something goes wrong in the DNA molecule, then likewise, something will go wrong in the living cell - most likely it will die.

In this A-T, you will learn the basic makeup of the DNA molecule so that you can understand how it controls our cells. Remove the colorful strip from envelope A. Now turn off the tape and list any observations you can make about the strip on your work sheet. When you are finished, turn the tape back on.

Did you list the following things?

1. All the colored strips appear in pairs.
2. In each case a long strip is paired with a short one.
3. Yellow is always paired with blue; green is always paired with red.
4. It doesn't matter whether the long strip appears on the left or the right. If you missed one or more of these, stop the tape and list them on your worksheet since this will be your study guide in the future.

Now that your list is complete, let's go back over what we've observed so far and see how this relates to the DNA molecule

MOLECULAR BIOLOGY
DNA STRUCTURE

The basic shape of DNA is like a ladder. The colored strips which you see here represent the rungs of the ladder. I will discuss the part that makes up the sides later.

The rungs of the ladder are formed by a type of molecule called a nucleotide base. There are four colors shown here since there are four different nucleotide bases. One of the observations made earlier was that the red and blue strips are all long while the green and yellow ones are all short. The colored strips are of two different length since the nucleotide bases are of two different sizes. They always appear in the combination of one short nucleotide with one long one. In this way all the rungs of the ladder are of the same width. This would not be true if some rungs had two long nucleotids and others had two short ones. Notice again that the long blue one only pair with the short green ones. These pairings are due to the chemical bonds which form between the two nucleotide pairs and hold them together. To understand this more fully, look at SLIDE ONE. Here you can see the bonds more clearly. Notice that between the blue and yellow nucleotide bases there are two dotted lines representing that these two moleucles bond in two places. Between the green and red bases there are three dotted lines representing three bond locations. You would not therefore find a blue unit with two bond locations joining a green one with three. That would be like trying to join two mismatched puzzle pieces. The four colors are used here merely to represent the four kinds of bases.

Within each is the first letter of the base. Adenine, the blue A always pairs with thymine, the yellow T, while quanine in red always pairs with cytosine in green. These four terms are listed on the study guide you will take with you.

The DNA ladder is not exactly straight. Hold one end of the strip in each hand. Now, gently - note, I said gently - twist the ends in opposite directions. This is how the DNA molecule appears in the cell - a spiral staircase.

What makes up the sides of this staircase? There can't just be rungs without anything to hold them together, can there? No, of course not. The sides of the staircase are composed of alternating units of phosphoric acid and a sugar. You can see this in SLIDE ONE. The phosphoric acid units are shown as purple circles with a P inside. The sugar is a pentagon - the five-sided figure with an S. The DNA molecule gets its name from this sugar- deoxyribonucleic acid or in simpler terms - a nucleic acid containing deoxyribose. What! You don't think that sounds so simple? Whether you're aware of it or not, you should understand this by now. I'll prove it to you. Look at SLIDE 2.

This is a nucleotide. Does it look familiar? It is the unit that makes up one half of a rung on the DNA ladder. Look back at SLIDE

MOLECULAR BIOLOGY
DNA STRUCTURE

1. Can you see the nucleotide units here? Each is joined to the one below by a bond between the sugar and the phosphoric acid. Each rung is completed by the joining of two nucleotide bases as explained earlier. Now look back at SLIDE 2. In DNA, the sugar in each nucleotide unit is called deoxyribose and from this sugar the molecule gets its name. The type of nucleotide is determined by which of the four bases is present. The type of bases present determine the characteristics of the organism. We will learn how this works at a future time.

Take the self-quiz which appears before you on the worksheet. When you have finished, turn on the tape to check your answers.

Here are the answers to the quiz. Make the corrections on your paper.

1. Figure I is the basic unit called c - the nucleotide.
2. The part labeled a, is b - phosphoric acid.
3. The part labeled b, is a - deoxyribose sugar.
4. The part labeled c, is c - a nucleotide base.
5. How many different kinds of nucleotides can be found in the DNA molecule? c - four.

If you feel you still have questions on this unity, rewind the tape and listen to it again or to the part you did not understand. When you have finished, rewind the tape and take your study guide with you.

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STUDENT GUIDE

Molecular Biology
DNA STRUCTURE

LIST BELOW THE OBSERVATIONS YOU CAN MAKE ABOUT THE STRIP IN ENVELOPE A.

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STUDENT STUDY GUIDE

MOLECULAR BIOLOGY
DNA STRUCTURE

SELF-QUIZ

Figure X

1. Figure I is the basic unit called

   a. a protein
   b. an amino acid
   c. a nucleotide
   d. a nucleotide base

2. The part labeled A is

   a. deoxyribose sugar
   b. phosphoric acid
   c. nucleotide base
   d. amino acid

3. The part labeled B is

   a. deoxyribose sugar
   b. phosphoric acid
   c. nucleotide base
   d. amino acid

4. The part labeled C is

   a. deoxyribose sugar
   b. phosphoric acid
   c. nucleotide base
   d. amino acid

5. How many different kinds of nucleotides can be found in the DNA molecule?

   a. only one
   b. 3
   c. 4
   d. 6

ADDITIONAL INFORMATION

DNA-DEOXYRIBONUCLEIC ACID
THE FOUR NUCLEOTIDES:

THYMINE PAIRS WITH ADININE
QUANINE PAIRS WITH CYTOSINE